

# THE WORLD SCANNER REPORT

A Journal of VHF-UHF Scanner Technology & Engineering

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## WE'RE BACK!

Vacation's over and it's back to work, and I mean WORK. We've got it cut out for us now. Since last issue, "Monitoring Times" Magazine invited me to take over the monthly Experimenter's Workshop column which I eagerly accepted. It's going to be a fun venture and probably quite rewarding for all of us, YOU dear readers included! See, "MT" has somewhere around 30,000 subscribers and that means my network of contacts will expand immensely. There will be loads of new ideas, suggestions, circuits, mods, and other things that can't all fit in the limited space for my MT column. There's a good chance I'll be inspired to take the "WORLD SCANNER REPORT" to greater heights with the overflow alone, and you will be the beneficiaries. Do I mind hard work? Not in the slightest, especially when it's fun! There's only a couple of things in this world that are more fun than writing about radio and we won't get into them here (grin). So what's up?

I will share a little with you: my first article for MT will appear in the July issue; a primer on CTCSS along the lines of which was introduced to you in Vol-2 of my SCANNER MOD HANDBOOK. You probably won't pick up much from that article, it's so basic, but 29,000 others will benefit. The August issue will have the plans & designs for a basic Remote Controller for the PRO-2004/5/6 and perhaps other scanners. As featured, the controller will handle up to three functions, SCAN, MANUAL and DELAY from a remote box attached to the scanner via a 9-conductor umbilical cable and an appropriate connector. Using the 9-conductor cable, and a bit of extra circuitry, up to 5 or 6 scanner functions can be controlled from the Remote. Now, if that whets your appetite for remote control, our beloved Professor Peabody has come up with a method to remote control all 29 functions with a wired controller. We may feature that mod either here or in "Monitoring Times" if there is sufficient interest. Let me know, ok?

The September issue of MT will have a neat little experiment for detection of CTCSS tones, and then the main attraction will be a method to use Radio Shack's Sound Level Meter as an Electromagnetic Field Meter! If you can do without a lot of detail, I'll give you a sneak preview of that nifty project later in this issue.

I'll have to watch my P's and Q's to avoid problems of ethics and conflicts of interest, so there won't be a lot of duplicity between the "WSR" and my MT articles, though the two might often contain the same subject matter. My articles for MT will be addressed to a general reader base of thousands; you guys 'n gals will get more hard core stuff; more nitty gritty, because you're hackers!

## LADY HACKERS?

Did I say, "gals" above? Sho' did! There are several lady hackers in our midst, one of whom is so eaten up with cutting, chopping & hacking radios that she might put a lot of us guys to shame. At last count, Joann Haines of San Mateo, CA had a PRO-2006, PRO-2020, PRO-32, Sony PRO-80, and no telling what else, all hacked to pieces and rebuilt to earth quaking, fire-breathing, smoke-blowing specs! Joann had the nerve to tell me she didn't really know what she was doing. Compliments to Joann for her daring and sheer audacity to hack!

## WELCOME NEW AND RETURNING READERS

A new subscription period has begun with this issue which means that new subscribers won't automatically receive all the back issues anymore unless requested. New subs start this month. If back issues are desired, they will be available at rates given on the subscription blank. The back issues are highly recommended because the nature of the "WSR" is a lot different from other magazines and newsletters. We won't repeat previously published info. Most info from Day One will be just as pertinent in the future as back then. A mod is still a mod, you see. We will be happy to adjust new subs to cover the back issues at the original cost for the near future. That is, subscribe for a year and get a discount off the 6-mos rate; two years gets an even better discount. The back issues to Jan-91 can qualify your subscription to get the appropriate discount. A hearty welcome to new readers this month and humble thanks to those who have continued!

## A SPECIAL ADJUSTMENT IN THE PRO-2004/5/6

To date, we have paid lots of attention to the "brains" of the PRO-2004/5/6, (the CPU) but absolutely nothing has been said about its "heart", the Reference Oscillator. Open your Service Manual for your PRO-2004/5/6 to the schematic diagram for the PLL Section. Hunt up IC-301 (PRO-2004) or IC-302 (PRO-2005/6). Next find Pin 1 of that chip, an MC145158. Follow the trace from Pin 1 and it will run directly to a nondescript little gizmo called "X-301". Bet you never noticed it before, or if so, you probably dismissed it as unimportant. The Service Manual pays it no attention and pretty much leads you to believe that it is just a 10 MHz crystal. It's not mentioned in the Alignment Instructions, either. Oh, but this little puppy is more than just a crystal, measuring 18mm x 8mm x 10mm high. X-301 contains a crystal; a transistor and a few other very special components and has the following visible markings: TEW & TX1824 with various suffixes. X-301 also has a little hole on top of its metal housing, sealed with a small square of clear tape. Inside that

hole is an ADJUSTMENT! And, for Pete's Sake, LEAVE IT ALONE until you learn what it's for and what it takes to tweak it and what will happen if you do.

Know how important the scanner's CPU is? Well X-301 is just as important if not more. Brains without hearts are about as worthless as the other way round. This baby is hot and we're not supposed to know about it for good reason! X-301 is the Master Reference Oscillator for the scanner. It's vital to run at exactly 10.00000 MHz give or take maybe 10 Hz. That's what the ADJUSTMENT is for and there is absolutely NO WAY to correctly adjust it without the proper tool and equipment. I wouldn't even tell you about X-301 except for a wonderful little use for it that I'll get into a bit later. But if I mention X-301 at all, then I'm obliged to tell the whole story, so bear with me here if you don't like tech stories.

X-301 has to run at an exact frequency or else the scanner won't run with precision; kind of like the timing of your car's ignition. That 10 MHz does a number of things in your scanner, one of which is to get multiplied up to around 600 MHz for use as the first I.F. injection frequency. So a 20 Hz error at 10 MHz, multiplied by 60 becomes a 1200 Hz error at 600 MHz. Not bad, but not good either. The fine razor's edge of your scanner's performance can be lost with errors in excess of 10 Hz. At errors of 40 Hz or more, it's sunk!

Now here is WHY Radio Shack doesn't tell us about that adjustment. Say you have a frequency counter. (Adjust X-301 without one, you're hopelessly mired.) With one, you're armed and dangerous! Inside the counter is a circuit (Time Base) that determines the accuracy of the counter which must be more accurate than the freq you're about to measure. Your freq counter is no more accurate than its Time Base, and in most hobby grade counters and lots of bench counters, the Time Base is pretty sloppy. I'm saying that you can't trust your frequency counter to be as accurate as required for X-301 adjustments. In fact, X-301 is probably more accurate and stable than any ten frequency counters around! Let's put it this way, I have several frequency counters; some good and some so-so and I don't trust any of 'em without first checking their calibration because the Time Base in each one drifts throughout the course of a day by as much as 200-300 Hz. Your counters are probably worse than that. But even if your freq counter is off by as little as 20 Hz, it's worthless by which to adjust X-301!

Now I am going to undo almost everything I just said by telling you HOW to adjust X-301, but there are some restrictions. Read 'em and heed 'em. First, the tool necessary to adjust X-301 can't be found just anywhere. In fact, I don't know where to find the PROPER tool. The adjustment in there is a little weird, but the #4 flat-blade screwdriver in Radio Shack's Precision Screwdriver Set, #64-1948, will get the job done if you're gentle and careful. Nothing else will work that I know of without damaging the adjustment head of X-301, and if you do that, you're dead in the water. Now that you're armed

with the right tool, here's how to bring the US National Bureau of Standards into your shack.

You'll have to have a shortwave receiver capable of receiving WWV at 10 MHz. As you may or may not know, WWV in Ft. Collins, Colorado and WWVH in Hawaii each broadcast a 10 MHz standard frequency along with Time of Day and other standard signals. We'll use their 10 MHz RF carrier because it is certified to be accurate to within one part in  $10^{11}$ , and it just happens to match the 10 MHz X-301. You can't beat that with a stick!

Now tune in WWV or WWVH at 10 MHz and make sure you can get a fairly decent signal. At certain times of the day, it may fade or be hard to detect. If so, wait for a better time, because you have to have a fairly stable, clean WWV signal. A little noise won't hurt, but you better be able to hear the voice announcements each minute and the tones in between the minutes. Assuming that you have a decent WWV signal available, pop the case on your scanner and locate the PLL sub-chassis on the bottom side of the PRO-2004/5/6. Pop the cover off the shielded compartment that contains X-301 and take a moment to familiarize yourself with everything you need to know. Identify X-301 and the 16-pin MC145158 chip. Then locate Pin 14 of the chip, which is the source for the 10 MHz output of X-301.

With your SW receiver tuned to WWV at 10 MHz, touch the end of a short 6"-12" (insulated) wire to Pin 14 of the MC145158 chip. Immediately you'll note a different sound out of the shortwave receiver! That's because the 10 MHz signal from X-301 will radiate out the wire and be picked up by the SWL receiver, same as WWV. It will be helpful if your receiver has an S-Meter for a visual indication of what's happening, too. We will use this "sound" (and the S-Meter), if your SW receiver has one, to adjust X-301 more accurately than virtually any frequency counter ever could!!!! If the signal from X-301 totally overrides WWV's signal on your receiver, cut a few inches off the wire you're using to touch Pin 14. The idea is to be able to hear (and see) both WWV and X-301's signals at the same time at about the same strength, give or take a little either way.

Now, we have to digress again so that you can understand what we're about to do. Get someone to gently whistle a very steady tone, say about 1 KHz, and then you do the same. Have the other person hold their tone very steady while YOU adjust yours to theirs. As your tone comes close to matching the other's, you'll begin to "hear" a flutter or a warble, which will slow down the closer the tones get to matching, and which will speed up, the farther away they get from a match. If your tone exactly matches the other, there will be no warble or flutter and the two tones will "harmonize" in an indescribable sort of a way. You'll see what I mean with a little practice. This process is called "zero beating".

Now, back to WWV, the scanner and X-301. WWV transmits an exact 10 MHz, and X-301 will "transmit" pretty close to,

but not EXACTLY 10 MHz. You will "hear" what's going on by listening to the receiver as the wire is touched to Pin 14 of the MC145158 chip. If your SW receiver has an S-meter, so much the better: watch it as you listen to the sound. Now, peel away one corner of the tape that covers the hole in X-301. Gently tweak X-301 a bit in one direction; instantly you'll hear a difference out of the SW receiver. If you went the "wrong" way, that difference will "speed up"; if you went the right way, it will "slow down". If you're watching an S-Meter, it will jiggle faster when you tweak X-301 the "wrong" way and slower in the "right" direction. Now tweak X-301 in the "right direction" slowly, gently and a bit at a time, all the while listening to what's coming out of the SW receiver. When you get X-301's frequency to match WWV's, you'll know it. The "effects" will slow down to zero. Tweak X-301 back and forth a few times to see what I mean. You just kind of "rock" it in until things are right. It's a hell of a process to describe here, but you'll know when it's right. And, when it is right, X-301 will be within 1 or 2 Hz of WWV's standard frequency. That's your objective; to get it "right".

You might occasionally, during this process, remove the wire from Pin 14 to orient your senses to pure WWV. Then touch the wire to Pin 14 again and you'll "sense" any differences. The whole process takes only a few seconds after you understand what to do; what to listen for and what to watch for on the S-Meter. It is neither mystical nor arcane; just harder to describe than to do.

After you become comfortable with this procedure, you can use it whenever a WWV 10 MHz signal is available to keep tabs on the condition of X-301. That's when you will be pleasantly surprised! It will rarely need readjustment! At the beginning of this article, I spoke of accuracy and stability. X-301 is a precision Temperature Compensated Crystal Oscillator (TCXO) which will rarely if ever drift out of tolerance. Once adjusted, a TCXO tends to stay adjusted. I would be surprised if it needed readjustment more than once a year, to tell you the truth, and even then.....?? That's the neat thing about X-301, which takes us next to the "wonderful little use for it" that I mentioned earlier.

#### USE YOUR PRO-2004/5/6 AS A PRECISION FREQUENCY STANDARD

NOTE: Even if you don't have a SW receiver with which to verify and adjust X-301 per the above procedure, you can still perform the below modification with high confidence that the 10 MHz output will be within 20 Hz of exactly 10 MHz. That's pretty great!

Trim all but about 1/8" of the leads of a 0.01-uF disk capacitor and carefully solder one of the leads to Pin 14 of the MC145158 chip. To the other leg of the cap, solder the center conductor of a section of mini coax cable such as RG-177/U (impedance doesn't matter), and I suppose you could use RG-58, though it's a bit bulky and large for the purpose. Solder the shield of this coax to the sidewall of the metal compartment that houses X-301 and

the chip. Route the coax to the rear of the scanner's chassis and install a BNC jack RS #278-105. Solder the center conductor of the coax to the center pin of the BNC jack, and the shield of the coax to the metal chassis or to the BNC ground lug, if it has one. Now trim a notch or hole in the cover of X-301's metal shield compartment so the cover can fit back on over the coax. Voila! Now you have a precision 10 MHz output that can be used for anything from calibrating frequency counters to just periodically checking X-301 against WWV without having to take apart the scanner! To calibrate a freq counter, first do the WWV "zero-beat" test to make sure that X-301 is pretty close. Then connect the counter to the 10 MHz BNC jack and adjust the counter's internal calibration trimmer so that it reads 10.00000 MHz. Check both X-301 and your counter periodically, and you'll soon learn how driftily the counter can be. You'll also learn how rock-solid X-301 is; a space-age miracle of accuracy and stability. The 10 MHz Output jack can provide your shop, shack or station with a new dimension in precision and confidence in the accuracy of your equipment.

EPILOGUE: I have evaluated X-301 in every PRO-2004/5/6 that has crossed my bench since 1986....and in all that time, the worst case of inaccuracy I have noted was about 40 Hz, and that unit had problems! The rest have been within 20 Hz and most within 10 Hz. Therefore, even if you have no method or desire to adjust X-301, you can still use the above modification as a standard frequency output for a variety of purposes! Also interesting, I have been evaluating a spare X-301 that I installed in a small metal box and keep powered up, night and day. I check it several times a day against WWV, and so far, it has not drifted more than 4 Hz. Most of the time, it stays within 1 or 2 Hz of WWV, despite daily ambient temp excursions of 60-80 degrees in my shop.

So why did I tell you all this? Maybe I ought to have my head examined, *because a perfectly fine scanner sure can get all boogered up* by indiscriminate monkeying around. On the other hand, the neat things about X-301 are just too rare and valuable to keep to myself. Everyone trusts frequency counters these days like babies trust their Mamas, but that's the wrong thing to do. A freq counter is no more accurate than its Time Base Oscillator, and most in the hobbyist's price range are good for no closer than 500 -1000 Hz, with 200 Hz at best. Hobby counters are typically specified to have a Time Base accuracy of 1-ppm but that's when it leaves the factory. Mfgs don't mention DRIFT in their literature. So you can see why a freq counter is no good for adjusting X-301, but if I hadn't told you, then sooner or later you'd have discovered X-301 all by yourself and that little hole would have whispered, "Adjust me, adjust me!". And you would have grabbed up your trusty freq counter and gone to town....and to oblivion. Now there's hope...because you can adjust X-301 correctly and at the same time, calibrate your freq counter for other precision needs! Interested in potential health hazards of 60 Hz A/C fields around your home, property and neighborhood? Please turn this page for a defense!

## CONVERT A SOUND LEVEL METER INTO AN EM FIELD METER

All you need is Radio Shack's Sound Level Meter, #33-2050 and their telephone pickup coil, #44-533. It would be helpful to also get a closed circuit 1/8" phone jack, #274-248. The idea is to substitute the telephone pickup coil in place of the microphone element and voila! The Sound Level Meter becomes an Electromagnetic Field Meter capable of measuring the relative strength of 60-Hz AC fields which are now coming under the scrutiny of medical and science professionals because of possible health hazards. The meter will detect the presence and relative strength of a wide range of VLF fields, weak to very strong, continuous and intermittent. Who knows what dangers lurk in those AC fields? Scientists and doctors don't know for sure, but there are grounds for suspicion.

The idea is to wire in the phone jack on the back case of the meter so that when the telephone coil is not plugged in, the instrument functions for the intended purpose of measuring sound levels; but when the telephone coil plugs into the jack the mic is automatically disconnected, and the coil becomes the sensor for EM fields. The electronic part of the Sound Level Meter can handle either function without alteration because 60 Hz audio or VLF EM field signals are well within its spec. The mic converts sound waves into electronic signals while the coil converts alternating EM fields into similar electronic signals. Those electronic signals from either sensor are the very same, you see. It is that simple, believe me, but if you don't understand this process, wait for the Sept 91, issue of "Monitoring Times" where all the gory details will be clearly laid out.

To operate it as an EM Field Meter, just plug in the telephone pickup coil; select the "C Weight" and "Slow Response" functions on the meter; and put the coil on or near things that you suspect emit EM fields. Adjust the meter dial for an appropriate reading. The "120 dB" position is the least sensitive setting which measures very strong fields. The "60 dB" position is the most sensitive which measures extremely weak fields. The range of measurement from weak (50 dB) to strong (126 dB) is 76-dB, or a ratio of nearly 40-million to 1. Not bad for an investment of under \$40, tops.

## FROM THE FIDONET COMPUTER NETWORK

### Message #8532 - SHORTWAVE

Date : 26-Apr-91 00:34  
From : David Stark  
To : Steve Jennings  
Subject : AOR AR-1000

> You said that you had an AR-1000 but you sold it. I  
> was looking at that scanner & would greatly appreciate  
> a "yea" or "nay" on purchasing one from someone who has  
> had experience (good or bad) with it.

It was probably me. The AR-1000 and the Icom IC-R1 are the only portable scanners in their class. Icoms are

still very hard to get, so AOR pretty much has the market to themselves. If you must have a portable that covers the full frequency range, it is your only choice. That being said, to me the AR-1000 was a disappointment. I found the adjacent channel rejection and general selectivity to be extremely poor. Sensitivity was excellent, which is actually a drawback in combination with the problems that I mentioned. The attenuator had varying effects on received signals depending on freq and mode. The silliest thing about the AR-1000 is the lack of SSB. A scanner is a utility monitoring device and if it includes the HF bands, it should be capable of detecting the primary utility voice mode. In practice, the addition of coverage below 25 MHz is overkill. You just can't carry an antenna on a portable radio that will give decent performance all the way from 8 MHz to 2 GHz. The short answer is - I would not buy another one.

\* Origin: NF2G / KNY2DJ / RCMA NY-172 / (1:260/218)

### Message #8984 - SHORTWAVE

Date : 01-May-91 12:31  
From : Dwayne Rich  
To : Timothy Dobbins  
Subject : AR1000 Scanner

Well I own an AOR 1000 and I think it's big advantages are being able to pick up shortwave broadcasts and have 1000 channels. It's disadvantage is it's price and the scan rate and the birdie you mentioned. I find a birdie on only one frequency around here and that frequency is for a radio system that I can only receive on days when "skip" is prevalent anyhow. If they could increase the scan speed it would help. Oh one more thing it is sometimes a victim of "overload" from a nearby repeater when I have it in scan mode. If I had the choice and I didn't need the 1000 channels I would get a Bearcat 200xt if I needed the 1000 channels I would get the AOR.

\* Orig:Beancounter's Paradise Pt Cary,N.C. (1:151/1000.20)

### Message #4364 "SWL/Scanners"

Date: 03-May-91 07:39  
From: Tom Eagan  
To: All  
Subj: AR-1000

I received my AR-1000 monday. The good news is it seemed to be as good as (even better) that the 3 (nsitivity). The instructions were much better than I had hoped for and when I called ACE a few questions the were answered on the spot. The programing and search functions are a little screwy and there are quite a few more key-strokes to it than in the 23 or 200 but the extra effort gives a range of options when doing the programing. Like select the mode/bank and channel. Thats the good news - the bad news is that on Thursday it hung up and would not scan or search. I called ACE, they said sounded like the processor was shot and to send it back for a replacement. I had bought it from Scancommunications in Iowa (\$355). Quite a good price if you consider that you get a case, nicads a charger for ac and one for auto (car) use. Of course the big problem now seems to be its short life.

More to follow when I get my new 1000. If anyone has any questions post them and I'll try to answer them. By the way - most of the things that were complained about in another posted msg, birdies, a/c sensitivity etc were NOT experienced by me. Perhaps AOR has corrected these problems?! \* Origin: Gandalf's 619-466-9505 (1:202/302)

Message #7693 - Scanner Conference

Date : 09-May-91 11:56  
From : Tom Eagan  
To : All  
Subject : AR-1000

Next chapter - After returning my first AR-1000 (it would not scan or search), yesterday I received the second one. Opened the box, threw in some freqs but nothing.... Seems this one will receive fine in the manual mode but will not stop scanning even with the squelch wide open. I called ACE and they said that they would send me another one (UPS overnight) and also have the second defective one picked up by UPS. (The first one cost me \$8 to return to them. As I said before - what little I have been able to use them the sensitivity and selectivity were as good as or even better than my 2006, 34 and 200 -- if only the thing would last for more than 2 days. It will be interesting, to say the least, to see what the third one will do, meanwhile UPS is making out like a champ. If any has any questions or comments on the 1000's operation, programing etc. post them and I'll try to respond. --- \* Origin: Gandalf's - 619-466-9505 (1:202/302)

Message #8948 - SHORTWAVE

Date : 27-Apr-91 06:27  
From : ELTON BYINGTON  
To : All  
Subject : Digital Signal Processor

There's an interesting review of a new digital signal processor in the May issue of 73 magazine. What this thing amounts to is a digital audio filter that accentuates voice and attenuates noise, if the signal you're trying to copy is slightly above the background noise level to begin with. Known as the NIR-10 Digital Signal Processor, the thing attaches between your receiver's output stage and the loudspeaker and, from what's said in the review, does a pretty good job of suppressing noise on the channel. Being a gadget freak, I ordered one. Should be here in a couple of weeks and I'll do a full report after I get used to the thing.

The review's on page 34 of the May issue of 73. This magic box is manufactured by JPS Communications, Inc., P.O. Box 97757, 5516 Old Wake Forest Road, Raleigh, NC 27609. (919) 790-1048 for info. Price class: \$400.

\*Orig: Pinelands RBBS 609-859-1910 (8:950/2)(1:266/22.32)

Message #3385 - SHORTWAVE

Date : 11-May-91 11:54  
From : John Hicks  
To : Bill Cheek on (1:202/719)  
Subject : Handheld Scanner Criteria

BC) Bummer. If you still have a PRO-34 or other intermod/BC) image/overload susceptible handheld, you might set up BC) an experiment using an attenuator between the antenna BC) and the scanner.

Bill, I live in an extremely RF-rich area and had mucho overload problems with my BC-200XL. Went to local Rat Shack and found an inline attenuator with F-connectors. Added F-to-BNC adaptors to each end and I just put it into the antenna line when needed. It really knocks out the overloads but apparently doesn't badly affect the reception range of the comms I want to hear. I usually use an antenna stuck on the top of my truck. Also, the BC-200 has less overload probs than my Regency HX-2200.

Message #4114 - SHORTWAVE

Date : 21-Jun-91 10:34  
From : Kirk Baxter  
To : All  
Subject : ICOM R7100; Replacement for IC-R7000!

**\*\*\*\* NEW ALL-MODE WIDEBAND IC-R7100 RECEIVER \*\*\*\***

>>> 25 to 2000 Mhz continuous coverage allowing you to receive VHF, UHF, amateur, marine, CB, utility bands, FM and TV Broadcasts.

- > All-mode capability.
- > 900 memory channels in 9 banks.
- > 20 Scan edge memory channels.
- > Dual scan with over 40 combinations.
- > High sensitivity and reliable frequency stability.
- > 0.1;1;5;10;12.5;20;25;100 KHz & 1 MHz tuning steps
- > Built-in 24 hour system clock with 5 ON/OFF timers.
- > Effective 20 dB attenuator for strong signals.
- > Automatic tape recorder switch
- > Dial lock function.
- > Noise squelch and S-meter squelch.
- > CI-V system for computer control w/ optional CT-17.
- > Frequency announcement in English with optional UT-36.
- > Large function display with variable LCD backlight.
- > Easy-to-read S-meter plus FM center indicators.
- > AC and DC power operation.

Is your mouth watering yet? When will it come to these shores? Bah, no 30Khz steps. Price: ???? Cancel those IC-R7000 orders! Origin: ANARC BBS-Assoc.of North American Radio Clubs (913)345-1978 (280/3)

**EDITOR'S NOTE:** The above messages from the Pidonet were lightly edited for space economy.

**A READER ASKS.....**

From Bill Bowers; Oklahoma: In a forthcoming "WSR" how about comments on:

1. The AR-800 search increment in the 830-950 MHz Range is 25 KHz. Can this be changed to 5, 10, or 30?
2. The Bearcat BC-1 looks like a handy "traveling" scanner. I make a lot of multi-state trips and this

"preprogrammed" scanner would be nice if the available frequencies are good and fairly complete. Comments?  
3. Any comments on fixed and mobile antennas would help.  
4. I note that OK Highway Patrol has 800-900 MHz antennas but there is no listing for that frequency range for the State Police. Any reader help?

Keep up the fine work. Your WS reports are read, reread and appreciated. Don't know how you find the time and energy. Regards from Bill Bowers

**EDITOR'S REPLY:** (1) Probably not, Bill, since SEARCH steps are mostly a function of the hard programming of the CPU and we can't get to that part of it. (2) I think the BC-1 is geared to the urban yuppie and his BMW for the most part. I can't see it for the serious scannist because the programming is strictly police freqs on a state-wide basis and that programming would come from commonly published sources such as POLICE CALL & BETTY BEARCAT, which are nothing spectacular in terms of having the "good" frequencies. The BC-1 does not offer fire, medical or other emergency service coverage and you can't program it yourself. It does offer all 40 of the CB channels and the NOAA weather channels for whatever that is worth. (3) I am not an expert on mobile scanner antennas, (AND, there aren't that many around to choose from!) but I use Radio Shack's All Band Magnet Mount #20-012 and find it to be acceptable, if not great. (4) I don't have any Oklahoma frequency info available so we'll have to appeal to the readers on that one. There are four "WSR" subscribers in the Tulsa region, so maybe they know. Now there is a possibility, Bill, that the state bulls have configured their cars with cellular telephones! Lots of cops are doing that these days at their own expense, too! There's no difference between cellular and SMR antennas so they'd all look alike. My bet is cellular phones! (5) Time and energy are easy to come up with, Bill, when what you're doing is fun, exciting, challenging, and rewarding. My day begins around 6:30am and continues to about midnight, and I love every minute of it!

#### REDUCING ADJACENT CHANNEL INTERFERENCE IN THE PRO-2004, PRO-2005 & PRO-2006

By: "Professor Peabody"

This month we will tackle the problem of excessive IF bandwidth in the PRO-2004/5/6. I mentioned this to be a liability in these and other scanners in past articles. Adjacent Channel Interference (ACI) is not a big problem in rural areas of the country but in metro areas where digital pagers, police repeaters, and Ham Radio operators with powerful Packet Radio stations reign supreme, all sorts of noise can splash across the IF bandwidth in your scanner. The stock 15 KHz filter in these radios admits humongous amounts of ACI along with desired signals. We will modify the circuits containing CF2 in the 2004 or CF4 in the 2005/6 by adding a much narrower IF filter, and boy does it ever work like a champ!

There are two ways to approach this project. If you want to do the very best possible job, the main receiver board must be freed and lifted from the chassis so you can work from the solder side. It may be worth the time & effort in the long run, though. All mounting screws; the +5v regulator IC-8, and Q-32 must be freed from the chassis. When later reassembling IC-8 and Q-32 don't forget a dab of silicone thermal grease on the mounting face of each.

A more practical, albeit less professional, way to do this job, especially if you already have a bunch of modifications installed, or if the prospects of removing the main receiver board scares the hell out of you, is to clip or desolder a pin of IC-2 and work between the cut or desoldered points. The rest of this discussion will be on the easier method because I know most of you won't do it the other way, and I can't say as I blame you.

Figure 1, the schematic and wiring diagram will guide you in addition to the text below. This modification will consist of in/out switching a special NARROW filter in series with CF-2 (PRO-2004) or CF-4 (PRO-2005/6) to provide greatly improved rejection of Adjacent Channel Interference. We want to be able to have original filter action for most of our listening, and switch in the narrow filter for critical needs.

The first thing is to fabricate the IF filter switching assembly on a small piece of perf board. Make it as small as you can because it will be located above the circuit board from where the stock filter is located. A SPDT relay is used to switch the path between the two filters. You can use a variety of means to switch the relay, but the simpler approach involves an SPST toggle switch mounted on either the front or rear panels.

The most difficult-to-obtain item is the narrow IF filter but the kind you need can be salvaged from a junked CB radio, virtually all of which will have just what you need; a small black cube-like thing marked CFU-455H2 or maybe CFW-455H. If the filter comes out of a CB radio, it will be the right thing and different numbers won't matter. Otherwise, if you prefer Murata-Erie filters like those used in CB rigs, contact: MURATA-ERIE NORTH AMERICA, LTD; 1148 FRANKLIN RD SE; MARIETTA, GA 30067; (404) 436-1300, and specify part #CFW-455H or CFU-455H2. Either of those will be fine though the CFW is a bit better.

Another source, our usual favorite, is DIGI-KEY; Highway 32 So; THIEF RIVER FALLS, MN 56701. (800) 344-4539. They don't handle Murata-Erie products, but they do have a TOKO filter, part #TK-2331 that can be acceptable if you can't get a Murata-Erie filter. The TOKO filter is very small and fits nicely on a perfboard. A notch is on the top of the filter to designate the "IN" terminal. The middle leg hooks to +8 volts like the stock filter and the other lug is the "OUT" terminal.

A low current 12-volt relay is used to switch the new filter in and out of circuit. An LED can be added as an indicator. The resistor in series with the relay coil is to limit precious current drawn from the power supply. An SPST switch is indicated but you can control it anyway you want. 12 volts can be taken from the INPUT of the +5 volt regulator, IC-8. See the service manual for your unit for gory details that are not necessary here.

After your Narrow IF Filter & Relay board is built, it must be connected to the scanner. This is the hairy part

and where you need to be very patient and careful. Examine IC-2 in your PRO-2004/5/6 and find Pins 3 and 5. Select the pin that's easiest to work with and there are two ways to proceed: one is to snip the easiest pin to access, probably Pin 5 in the PRO-2005/6 and Pin 3 in the PRO-2004, but it's your choice. If you choose to snip the pin, do it as close to the circuit board as possible so as to leave some pin length to the IC-2. The second way is to desolder Pin 3 or 5 (your choice) and pry it out of the pin hole with a wedge tool while heating it. Either way, your objective is to separate Pin 3 or Pin 5 from where it enters the circuit board. Clip it or desolder it; your choice.

Raise the now free pin up from the circuit board area so that it clears where it used to go. Try to not break that pin off the body of IC-2. That would be kind of embarrassing, you know. If you do break that pin, you might still be able to tack solder a wire to the break later, but that's taking an unnecessary risk, so just be careful with the pin, ok? It's not the end of the world to have to replace IC-2, but you don't really want to do it if you don't have to. Try not to have to.

Refer periodically to Figure 1 to guide you as follows: With as short as possible (1/2"-1") stiff wires, solder the "INPUT", "OUTPUT", and +8 volt points on the new IF board to the appropriate points of the separated Pin 3 or Pin 5. By the way, +8v at the chip is Pin 4. You can solder directly to it. Of course, the relay and LED need 12 volts and ground but these are separate from the IF lines, and length is not important. As a final note, plan your installation carefully and make provisions to mount the IF board to something. I used silicone rubber underneath my board to glue it to a nearby capacitor and to make sure that nothing shorts out.

Now that the installation is complete, turn on the radio and check for proper operation. It should sound normal. Next, activate the circuit and listen for a reduced high

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frequency output of the audio. This is the proper action of the narrower filter. If no difference is heard check for operation of the relay. At the cathode end of the diode, D1, should be 12 volts when activated and 0 volts when not. When you've corrected any problems, scan to a channel with adjacent channel interference and activate the IF switcher. Hear how the offending noise is reduced or eliminated altogether? A slight, but welcome, increase in signal-to-noise ratio might be a side benefit here. Good luck till we meet again; 73/PROFESSOR PEABODY

**THE SCANNER MODIFICATION HANDBOOK CORNER**

**MOD-23 & MOD-29 NOTES FROM "PROFESSOR PEABODY"**

SEARCH & STORE; NOTE 1: My able assistant Sherman reminds me to tell you of the side benefits of the Extended Delay, MOD 29, now appearing in SMH, Vol-2. When using the Search and Store modules (MOD-23) from Key Research Co, the modules can get hung up from short bursts of RF. Refer to page 156 in Vol-2. Instead of hooking the ORANGE wire of either the PS-90 or the SS-45 module to the scanner's IC-3, Pin 3 as Key Research directs, hook the orange wire to U-1, Pin 6 of MOD-29, the 74HC00 NAND gate. Turn ON the Extended Delay and set it for about 0.5 to 1 second or so. A short burst of RF will still get processed by the SEARCH & STORE module but it can't possibly get hung up! Also, since you have added an artificial delay to the circuit, the module won't resume searching until the extended delay has finished. Just be sure to turn ON the Extended Delay if this anti-hang feature is desired. OFF, and everything is normal. Sometime, I will show you how to add an LED to this circuit to show delay time and squelch breaks.

SEARCH & STORE MOD-23, NOTE 2: Sherman, himself, found an additional benefit to the Speed Crystal Switch Mod that I presented in "WSR" V1N3. As you may know, the SEARCH & STORE modules don't usually work with the 10 MHz crystal speedup for the PRO-2004/5. If you switch in the stock

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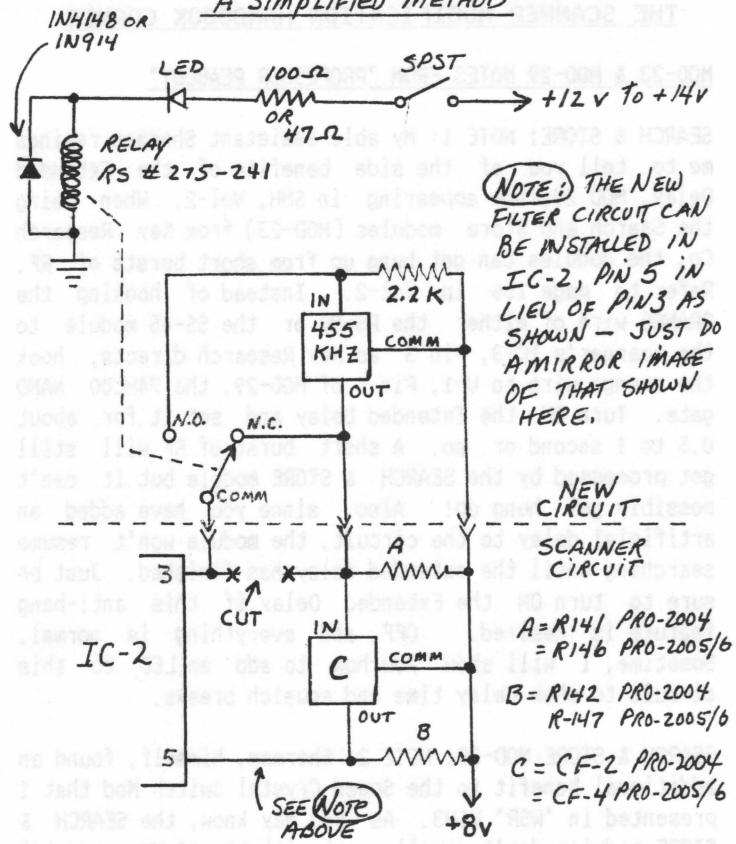
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7.37 Mhz crystal to operate the S&S modules and when finished, switch back to 10 MHz for 30-ch/sec, you can have your cake and eat it too! When my 2005 was a true 2005, I used this mod to operate my PS-90. It's the only way I know of to have a fast PRO-2004/5 and a SEARCH & STORE feature. Of course, the PRO-2006 can be sped up to 40-ch/sec (16 MHz) and still work just great with the SEARCH & STORE modules, thanks to its new CPU. 73/Prof

FIG 1: Narrow/Stock IF Filter Wiring/Schematic Diagram

## A SIMPLIFIED METHOD



#### ABOUT THE COVER PHOTO

[Photo and narrative by: Al Steigler, Hartford, CT.] Following are some things I've done to my scanner you might find interesting. I purchased a Temperature Indicator/Controller, Radio Shack #277-123 and two Electronic Counting modules, RS#277-302. I'm not one who likes to put things in a box so all three items were "super glued" to the lower front panel of my PRO-2006. The Temperature Indicator is on the extreme left side with a 12-seg DIP switch glued underneath for control. In the center of the scanner's front panel is the Counting Module for MOD-30, the Event Counter. To the right of this is a signal strength meter housed in the same kind of case the other two items are in. I removed a counter module from one of the units to use for the S-Meter. Now, get this: the light from the S-Meter shines through the top of the housing and gives INDIRECT LIGHTING of the entire keyboard. Also drilled a small hole in the Temp and Counting Module's face plate on the bottom where I inserted two bulbs, Radio Shack #272-1154 and completed the necessary wiring for all three goodies on the front panel. Even though I took power off the low side of the ON/OFF switch, I installed two SPST switches, Radio Shack #275-624 so I could control the lights in all three units independently of the scanner's on/off control. Several folds of aluminum foil are inside the panel of the Temp and Counting modules to keep the lamp bulbs from burning through. On the left side of the scanner (upper section) is a Micro-27 tape recorder, Radio Shack #14-1044. On the bottom of the scanner case are three 9-v battery holders, Radio Shack #270-326. If I'm out on the road and the memory battery is about to "expire" at least I'll have a spare so all my 6,400 channels aren't lost! (MODs 16/28.) MOD-31 is in the planning stages to be next.

**EDITOR'S NOTE:** I have reactivated my computer connection with GEnie Information Services. I can be reached there daily by B-Mail and on the Radio-Electronics RoundTable. My B-Mail address on GEnie is: W.CHEEKSRI.

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